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Climate change and gender equality in developing states

Joshua Eastin

Dept. of Political Science, Portland State University, United States

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ABSTRACT

It is commonly accepted that women can be more vulnerable than men to the adverse environmental effects of climate change. This paper evaluates whether the unequal distribution of costs women bear as a result of climate change are reflected across broader macro-social institutions to the detriment of gender equality and women's rights. It argues that gender disparities in climate change vulnerability not only reflect preexisting gender inequalities, they also reinforce them. Inequalities in the ownership and control of household assets and rising familial burdens due to male out-migration, declining food and water access, and increased disaster exposure can undermine women's ability to achieve economic independence, enhance human capital, and maintain health and wellbeing. Consequences for gender equality include reductions in intra-household bargaining power, as women become less capable of generating independent revenue. Outside the home, norms of gender discrimination and gender imbalances in socio-economic status should increase as women are less able to participate in formal labor markets, join civil society organizations, or collectively mobilize for political change. The outcome of these processes can reduce a society's level of gender equality by increasing constraints on the advancement of laws and norms that promote co-equal status. I empirically test this relationship across a sample of developing states between 1981 and 2010. The findings suggest that climate shocks and climatic disasters exert a broadly negative impact on gender equality, as deviations from long-term mean temperatures and increasing incidence of climatological and hydro-meteorological disasters are associated with declines in women's economic and social rights. These effects appear to be most salient in states that are relatively less-democratic, with greater dependence on agriculture, and lower levels of economic development.

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1. Introduction

It is tempting to assume that climate change equally influences the lives of women and men because the most visible effects occur on societal scales. Yet, because these effects are refracted through the economic, social, and political characteristics of the polity, the reality is that climate change poses a gender-specific set of risks that create disproportionate hardships for women. This paper evaluates whether the unequal distribution of costs women bear as a result of climate change are reflected across broader macro-social institutions to the detriment of gender equality. While existing scholarship has evaluated climate change's effects on women, and on gendered dimensions of climate vulnerability and adaptation in specific locations, questions remain as to the extent that environmental processes associated with climate change affect gender equality and women's rights. This paper addresses this lacuna through an empirical investigation into the impact of climate shocks and climatic natural disasters on women's social and economic rights across a sample of developing states from 1981 to 2010.

Vulnerability provides a conceptual framework for evaluating the impact of climate change on gender equality. Vulnerability comprises exposure and sensitivity to environmental threats, and capacity to cope with environmental crises (IPCC, 2001). Impoverished populations face higher levels of risk: they are more reliant on ecosystem services for livelihoods; more likely to live in environmentally exposed locations such as a flood plain or on a degraded hill slope; and possess fewer resources to adapt to changing environmental conditions and to recover from disasters. However, the poor are not a homogenous entity. Disproportionate household and familial burdens and a relative lack of control over productive assets can enhance female vulnerability beyond that of men (Goh, 2012). In many cases, discriminatory legal institutions and social customs exacerbate these vulnerabilities by heightening exposure and undermining coping capacity. The result is that women are more likely to be impoverished than men, less capable of adapting to present and future climate change impacts, and less likely to participate in and contribute knowledge to policy-making

E-mail address: jeastin@pdx.edu

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processes that facilitate gender-specific adaptation or mitigation efforts (Van Aelst & Holvoet, 2016).

Building on these insights, I argue that gender disparities in climate change vulnerability not only reflect preexisting gender inequalities, they also reinforce them. Inequalities in the ownership and control of household assets and rising familial burdens due to male out-migration, declining food and water access, and increased disaster exposure can undermine women's ability to achieve economic independence, enhance human capital, and maintain health and wellbeing. Consequences for gender equality include reductions in intra-household bargaining power, as women become less capable of generating independent revenue. Outside the home, norms of gender discrimination and gender imbalances in socio-economic status should increase as women are less able to participate in formal labor markets, join civil society organizations, or collectively mobilize for political change. The outcome of these processes can reduce a society's level of gender equality by increasing constraints on the advancement of laws and norms that promote co-equal status. While we should not expect these findings to apply to all women in equal measure, those of lower socio-economic status and those who rely on agriculture as a means of subsistence and production should be acutely vulnerable.

Empirical analysis substantiates these arguments. I test the relationship between climate change and gender equality with panel data from 1981 to 2010 for all countries classified by the International Monetary Fund as "Developing" or "Emerging Market Economies" (IMF, 2017). The findings suggest that climate shocks and climatic disasters exert a broadly negative impact on gender equality in these countries, as deviations from long-term mean temperatures and increasing incidence of climatological and hydro-meteorological disasters are associated with declines in women's economic and social rights. These effects appear to be most salient in states that are relatively less-democratic, with greater dependence on agriculture, and lower levels of economic development.

2. Gendered vulnerability to climate change

Scientists now agree with a high level of certainty that contemporary changes to the Earth's climate are unparalleled in recorded human history (IPCC, 2014). Increases in average global temperatures are fueling environmental processes that decrease the predictability of rainfall and moisture content of soils, elevate the intensity of environmental hazards, reduce biodiversity, and alter wildlife migration. Although some areas in far northern latitudes might experience benefits in the form of prolonged growing seasons, the macro-level impacts of climate change—increasing seasonal variability, glacial melting, rising sea levels, and altered precipitation patterns—are expected to increase proximate risks from storms, droughts, floods, landslides, fires, disease epidemics, and heat waves across much of the world. These effects will be especially pernicious in developing nations located in tropic and sub-tropic latitudes that rely on agriculture for subsistence and livelihoods, because these states are acutely vulnerable to climatological hazards that undermine agricultural productivity, and because they possess fewer resources to invest in adaptation. The poor, who tend to rely most heavily on ecosystem services, will be among the hardest hit, especially (but not exclusively) in rural areas where reduced water availability and agricultural output diminish livelihood options, undermine food security and subsistence capabilities, and necessitate outward labor migration.

Although these processes affect both women and men, the nature and degree of the impacts can vary accordingly. Prior scholarship in feminist political ecology and disaster studies offers insight into the causal drivers of gender disparities in climate change vulnerability (Mies & Shiva, 1993; Mies, 1998; Rocheleau, Thomas-Slayter, & Wangari, 1996; Salleh, 1997; Terry, 2009). These works assess how social and economic structures that ascribe distinct roles to women in society also expose them to distinct constellations of environmental risk. Gender imbalances in the division of labor and asset ownership, and the persistence of discriminatory laws and social norms that restrict women's rights and opportunities magnify the hardships women face in adapting to environmental conditions that reduce livelihood opportunities and heighten resource scarcities.

Gendered divisions of household labor common across the developing world disproportionately amplify women's vulnerability to climate change. While both sexes contribute to household preservation, men's responsibilities generally include cash-cropping or wage labor, while women's concern the management of resources necessary to ensure family nutrition and health—tending subsistence crops and small livestock, collecting water, and gathering fuel wood (FAO, 2003). When a climate shock disrupts income flows or food cultivation, or necessitates changes to water supplies or the distribution of crops, women often face greater challenges with adaptation. Buechler (2009), for example, finds that reduced water supplies due to higher temperatures in Sonora, Mexico amplify women's household responsibilities, as their traditional role as caregivers require them to remain stationary while men migrate to find employment. At the same time, decreasing employment opportunities in agricultural processing sectors diminish women's livelihoods, which undermine their economic self-sufficiency and reduce their ability to participate in customs such as gift giving that confer social status among female community members. In this case, the combination of rising household burdens, declining access to subsistence and financial resources, and limited opportunities to participate in the workforce and develop human and social capital serve to exacerbate gendered disparities in climate change vulnerability.

Inequalities in the ownership and control of tangible assets such as land, housing, livestock, and agricultural inputs can magnify these effects. Naraya, Patel, Schafft, Rademacher, and Koch-Schulte (2000, 5) argue that: "poor people rarely speak of income but focus instead on managing assets—physical, human, social, and environmental—as a way to cope with their vulnerability, which in many areas takes on gendered dimensions." Assets, especially land, are critical because ownership can provide physical protection, a way to mitigate and manage crises, and adapt livelihood strategies to changing environmental conditions (Deere and Doss, 2006). Across much of the developing world, land ownership is overwhelmingly male. In Africa, women are responsible for between 50 and 80% of agricultural production, but hold title to less than a 20% all agricultural land (FAO, 2016).[1] This disparity can create acute hardships for women when climatic changes undermine agricultural livelihoods, because ownership increases access to formal credit markets, which can enable individuals to cope with lost harvests, invest in new livelihood strategies, or purchase agricultural inputs that can reduce production volatility (Nuryartono, 2005).

This "gender-asset gap" can magnify female vulnerabilities in other ways as well (Deere & Doss, 2006; Deere & Leon, 2003). Dillon and Gill (2014) find that gender inequalities in access to agricultural technologies (irrigation equipment, motorized tillers,

[1] There is considerable interstate variation in land ownership: in Mali, women hold only around 5% of agricultural land titles; in Zambia, the number is around 15%, and Malawi, 32% (FAO, 2016). Figures are similar for South and Southeast Asia, and Latin America, and much lower for the Middle East (FAO, 2016). However, even when women technically "own" assets, husbands or extended family members can often mediate control See for example: Quisumbing, Roy, Njuki, Tanvin, and Waithanji et al. (2013).

etc.) can aggravate disparities in crop production during a climate shock. While men's control over these resources enables them to maintain output sufficient to almost offset the shock, women experienced proportionally diminished harvests.

The impacts of climate change on the gender-asset gap can be self-reinforcing when vulnerable populations are forced to sell their assets in response to declining livelihoods, and when degradation and sea-level rise decrease their use- and exchange-values. Although evidence for a rising gap between husbands and wives is limited (Quisumbing, Kumar, & Behrman, 2017) climate change is likely to have a significant effect on the gap among female-headed households and dual-parent or male-headed households (Flatø, Muttarak, & Pelser, 2017). Female-headed households are more likely to be impoverished and chronically food insecure, more likely to have a higher number of non-working dependents, and more likely to experience greater limitations on mobility and earnings potential because women must perform both domestic duties and act as primary breadwinners (Rosenhouse, 1989; Flatø et al., 2017).[2] A climatic shock that undermines livelihoods should only amplify these burdens, leaving asset sales and savings expenditures as the most viable coping mechanisms.[3]

Finally, patriarchal social and legal institutions prevalent in many developing states exacerbate both gendered disparities in vulnerability as well as the relative difficulties women face in adapting to climate change. For example, traditional inheritance and marriage dissolution practices exacerbate the gender asset gap (Peterman, 2012). Greater inheritances for women are associated with higher socio-economic status, indicating that this problem is especially acute among the poor. Customs such as these can even conflict with formal laws: In Tajikistan, the law authorizes joint land ownership between husbands and wives, yet few women are registered landowners because many rural marriages are not documented, and therefore not covered under the law (Djusaeva, 2012). In India, men and women hold equal land ownership rights, but women own less than 10% of all private landholdings. One reason for this disparity is that families view dowries paid to sons-in-law as a portion of daughters' inheritances even though the assets are transferred to the husband and his family (Scalise, 2009). The result is that in cases of disagreement, divorce, separation, or death, women stand to lose not only assets, but also future income sources and a hedge against disaster.

The effects of discriminatory institutions on female vulnerability to climate change are also evident when assessing gender disparities in health and wellbeing. Because women's responsibilities in the household division of labor usually include gathering resources necessary for family subsistence, environmental changes that decrease resource access and amplify domestic burdens can also undermine women's health, in some cases placing them direct physical jeopardy. Reductions in the availability of water and fuel-wood increase the risk of sexual assault when women are forced to travel farther for collection (Brody, Demetriades, & Esplen, 2008). This scenario is especially prevalent in conflict zones, refugee camps, and other ungoverned or insecure spaces. Scholars have also found that drought-induced economic shocks and crop failures can increase the risk of disease when women are compelled to engage in transactional sex as a means of income generation, or when husbands expose wives to sexually transmitted infections upon returning from labor migrations (Burke, Gong, & Jones, 2015; See also: Swidler & Watkins, 2007; Dinkelman, Lam, & Leibbrandt, 2008; Robinson & Yeh, 2011).

Natural disasters, which are expected to grow in magnitude as climate change progresses, pose similar challenges. Customs such as traditional dress codes and norms against teaching women to swim can heighten female death rates during floods (Alam & Collins, 2010), while women's responsibilities as familial caregivers can magnify the difficulties of self-rescue because of the need to attend to children and the elderly (Schwoebel & Menon, 2004). Similarly, discriminatory practices in a disaster's post-crisis phase can undermine women's access to relief resources and increase interpersonal violence against them (Neumayer & Plümper 2007). Case analyses provide supportive evidence. In Namibia, the tendency for wives to act submissively toward their husbands increases physical and psychological stress in times of food insecurity, because it is expected that women will attempt to exhaust all available means of resolving scarcities before speaking with their husbands (Angula, 2010). In Kenya, it is common for women to deliberately decrease food consumption in response to drought-induced food shortages, which increases health risks among women, children, and pregnant and lactating mothers (Serna, 2011).

3. Vulnerability and gender equality

This paper argues that gendered disparities in climate change vulnerability not only reflect preexisting gender inequalities, they also reinforce and strengthen them. The result can perpetuate a "vicious circle [whereby] the more women are affected negatively by climate change, the worse the inequalities get. And the worse the inequalities get, the worse the impact becomes" (Panitchpakdi, 2008, 107). Work in neoclassical and feminist economics on intra-household bargaining behavior lends insight into causal dynamics (Folbre, 1986, 1989). In household bargaining models, household decision-making outcomes are conceptualized as the product of preference contestation among household members. An individual's contribution to household income and their control over household assets determine the bargaining power they command (Rogers, 1990). For women, gains in bargaining power can promote empowerment by increasing their participation in decisions over childbearing and care, allocation of household resources, mobility, and occupational participation (Iversen & Rosenbluth, 2006; Ashraf, Karlan, & Yin, 2010; Aslam & Kingdon, 2012; Thomas, Contreras, & Frankenberg, 1997).

In the context of climate change, gender disparities in vulnerability are likely to magnify inequalities in intra-household bargaining power, with implications for gender equality and women's rights at both the micro- and macro-levels. Rising familial burdens due to male out-migration and declining food and water security, coupled with a relative inability to employ productive assets to cope with climatic shocks, should decrease female income generation capabilities, mobility, opportunities to build human capital, and access to formal credit markets. The result can reinforce gender disparities in the household division of labor and heighten female reliance on male income, which increases the opportunity costs of divorce and reduces women's independence. These effects can also increase the likelihood that gender discrimination and stereotypes will persist across generational divides. Because parents have an incentive to prepare children for what they expect their adult responsibilities to be, and because children learn via socialization, the greater the level of female subordination in the household, the more likely these norms will be passed along (Iversen & Rosenbluth, 2006; Eagly & Steffen, 1984).

Environmental changes that undermine women's ability to generate independent revenue streams can also affect gender equality

[2] While the percentage of female-headed households varies significantly across the developing world, many of the least developed states possess the highest numbers, with states such as Swaziland, Zimbabwe, and Haiti approaching 50% of all households (World Bank WDI, 2016).

[3] Preexisting inequalities coupled with increased familial burdens can potentially undermine other possible coping mechanism such as credit market access or the opportunity to migrate to more prosperous areas.

by reducing children's health and educational opportunities (Mishra & Sam, 2016; Menon, Van Der Meulen Rodgers, & Nguyen, 2014). Education is important because it enables girls to enhance their human capital and future earnings potential, delay marriage and childbirth, and encourage contraceptive use, and because female education can facilitate the development of social norms that discourage gender discrimination. The greater the share of women's contribution to household income, and the greater her control over household assets, the more likely girls will be to attend school. Qian (2008), for example, finds that increasing women's share of household revenue in China increases educational participation for both male and female children. In contrast, when a man's share of household revenue increases relative to woman's, girls' educational participation declines and boys' remains static. Thus, while children of both sexes can benefit from increasing female empowerment, reductions in female income disproportionately hurt girls (See also: Foster, 1995). Additionally, when household livelihood and subsistence capabilities diminish overall—when both male and female income declines—girls also bear greater costs. In a study of the effects of climate variability on children's education in Uganda, Björkman-Nyqvist, (2013) finds that negative deviations in mean annual rainfall (droughts), have a significant adverse impact on primary school enrollment and test scores for older girls, but no impact on school attendance or performance for boys or younger girls. The findings suggest that during episodes of resource scarcity, 1) households prioritize resource access for male over female children, and 2) are more likely to use girls as supplementary domestic labor, which reduces their school attendance. Similar findings hold true for girls' health: Qian's (2008) study also finds that increasing a woman's share of household revenue improves daughters' survival rates. This outcome occurs because greater bargaining power enables women to demand a larger share of household resources for daughters, and because the potential that girls hold future value in the labor market can increase the opportunity costs of childhood gender discrimination in access to these resources.

As this discussion indicates, the impact of increased vulnerability to climate change should not only affect gender relations at the household level, but should also have consequences for women's rights at the macro (societal) level. Factors that magnify domestic burdens and undermine women's status within the home should also reduce their ability to develop human capital, build robust social networks, and join civil society organizations. Consequences can include: increasing constraints on women's ability to achieve gainful employment, especially in non-sexually stratified occupations; achieve authoritative positions in the workforce; and to collectively mobilize for public goods to support women's issues. The outcome can reduce public support for laws and norms that promote coequal status, and increase impediments to the development of post-materialist values that discourage gender discrimination (Inglehart 1977, 1997). Taken together, these insights inform the following hypothesis:

H1. *Environmental processes associated with climate change should generate a negative effect on women's rights in vulnerable states.*

H1 enables an empirical assessment of the relationship between climate change and women's rights. It rests on the assumption that vulnerability and livelihood sensitivity to climatic stressors are important conditional determinants. Accordingly, structural conditions that bear on household and gendered vulnerability disparities to climate change should influence the magnitude of these impacts. Households in relatively poorer and more agriculturally dependent economies are likely to possess greater exposure and sensitivity to climatic processes and reduced capacity to cope with climatic disasters. Similarly, relatively less-democratic political institutions are likely to correlate with lower levels of responsiveness to the needs of a population, and lower governmental capabilities (or political will) to provide social services that can mitigate or alleviate livelihood shocks. While each of these characteristics should influence a population's absolute vulnerability to climate change, they might also affect disparities in vulnerability among women and men (Denton, 2002). Poorer economic prospects, greater reliance on agriculture, and less democratic governmental structures can also be associated with more substantial female household burdens, reduced opportunities for female empowerment and human capital enhancement, greater prevalence of patriarchal norms that undermine women's status, and lower social support for women's issues that can decrease vulnerability (Goldin, 1995; Eastin & Prakash, 2013). The preceding logic informs hypotheses two (H2).

H2. *Climate change should have a greater impact on women's rights in less-developed states with greater dependence on agriculture as a means of production, and less-democratic political institutions, than those that are relatively more developed, industrialized, and democratic.*

4. Data and variables

To test the impact of climate change on women's rights, I have compiled a cross-sectional, time-series dataset of developing states from 1981 to 2010. The unit of analysis is the country/year.

The time period was selected because it corresponds to data availability of the key variables of interest. Countries were included in the sample if they fall into the "Emerging Market" or "Developing" economy categories of the International Monetary Fund's World Economic Outlook Database (IMF, 2017). These classifications are based on countries' 1) per capita income levels, 2) their integration into world financial markets, and 3) their level of export diversification, a category which prevents countries with a high GDP per capita from classification as "advanced" economies if they derive a significant share of their income from petroleum exports. In total, 151 countries are included in the IMF database, though the maximum number of countries included in any one estimation is 127 because of disparities in data availability among the variables included in the analysis. A full list of all countries included is the dataset is located in the Appendix. To the best of my knowledge, this analysis provides the most comprehensive (and perhaps the only) cross-national assessments of climate change on women's rights.

4.1. Dependent variables

The dependent variables capture a society's adoption of women's rights and norms of co-equal status as an approximation of gender equality. Data is drawn from the *Cingranelli-Richards Human Rights Dataset* (CIRI), which has developed indices that evaluate these concepts across countries over time (Cingranelli, Richards, & Clay, 2014). *Social Rights* measures whether women in society hold rights to equal inheritance; to own and control property; to live where they like; to marry whom they choose and initiate a divorce; to obtain a passport and travel abroad; to confer citizenship to a spouse or child; to participate in social and community activities on an equal basis; to be educated; and to be free from the threat of genital mutilation and forced sterilization. *Economic Rights* measures whether women enjoy rights to equal pay for equal work; to equality in hiring practices; to choose whether they work and their specific profession without male consent; to equal levels of job security; to non-discriminatory employment practices; to enjoy a workplace free of harassment; and to work at night, in dangerous jobs, and in the military and police

forces. Both of these variables are indices that are ranked on an ordinal scale from zero to three. Higher numbers indicate greater equality. The rankings depend both on whether these rights exist in law (de jure), and the extent that the government actively enforces them (de facto). Further details on coding practices, as well as information on primary data sources can be found in Cingranelli, Richards, and Clay (2013).

The CIRI indices on women's social and economic rights are preferable to alternative measures of gender equality because they most closely approximate the outcomes discussed in the study, and because they are among the most comprehensive and robust measurements available. Other indices, such as the UNDP's Gender Development Index (GDI), Gender Equality Measure (GEM) and Gender Inequality Index (GII), have far lower data coverage, while, the GDI and GEM have been the subject to criticism for their unreliability and lack of comparability across cases (Klasen, 2006). An alternative strategy might also have been to choose a variable that captures an isolated dimensions of gender equality—gender disparities in infant mortality, for example—however measurements such as this are less comprehensive and much less precise for measuring women's rights across various legal and social institutions.

Data for *Social Rights* is available from 1981 to 2005, while data for Economic Rights is available from 1981 to 2010. Although thirty years is a relatively short period, it is adequate to capture intertemporal variation in CIRI scores sufficient to justify empirical analysis. For example, Guyana transitions between scores for Economic Rights fifteen times between 1981 and 2010; Sudan transitioned ten times, Turkey twelve times, Iraq six times, and Thailand ten times.

4.2. Key independent variables

Key independent variables approximate environmental processes associated with climate change. The primary measurement gauges the occurrence of climatic shocks, which are expected to rise in frequency and magnitude as climate change progresses. *Temperature* measures standardized deviations in inter-annual temperature estimates from the panel mean for each country in the sample. The formula for calculating this measure is $(\mathcal{X}_{it} - \bar{\mathcal{X}}_i)/\sigma_i$, where $\bar{\mathcal{X}}_i$ is the panel mean for country *i*, $\mathcal{X}_{it}$ is the temperature estimate for country *i* at time *t*, and σ_i is country *i*'s standard deviation. This process results in a standardized temperature measure with a mean of approximately zero (−1.49e-08), a range of −2.9 to 3.3, and a standard deviation of 0.98. I also include *Precipitation,* which measures standardized country-level rainfall deviations using the same formula. The *Precipitation* variable has a mean of approximately zero (−7.34e-10), a range of −3.6 to 4, and a standard deviation of 0.98.

Raw data for both these variables are drawn from Burke, Hsiang, and Miguel (2015). These authors derive annual country-level estimates from the "Terrestrial Air Temperature and Precipitation: Monthly and Annual Time Series Dataset (v. 3.01), which provides global annual mean temperature and precipitation data at a 0.5 × 0.5 degree resolution (Matsuura & Willmott, 2012). Burke et al. aggregate these grid cell values to the country-year, and weight them by population density in the year 2000, using data from the Gridded Population of the World. Data for *Temperature* and *Precipitation*, variables are available across the entire time period under study, from 1981 to 2010.

While I include both *Temperature* and *Precipitation* measurements in the analysis to account for the possibility that one effect might mask the other, I anticipate *Temperature* to be the more robust measure, and positive temperature shocks to generate greater impact across cases. Rising temperatures and temperature variability are the most consistent environmental effect of climate change, and can generate an array of adverse effects for livelihoods and food security, particularly in developing nations in tropic and sub-tropic latitudes (IPCC, 2014). While rainfall shocks can also influence these processes, the directionality of rainfall's effects is not universal, which might affect the interpretation of their impact on the outcome (Eastin, 2016). In other words, in some locations such as the Sahara, Sahel, and some states in Sub-Saharan Africa, a positive rainfall shock can encourage agricultural growth, and therefore be a boon to food security and livelihoods. In contrast, too much rain in rice-producing states in Southeast Asia, especially at certain times of the year, can diminish production. Thus, the predicted directionality of *Rainfall* is less consistent.

Temperature and *Precipitation* provide a useful approximation of climate change because they are entirely exogenous to existing socio-economic and political processes that could influence gender equality independent of the climate. However, a challenge arises from attempts to measure these variables at the country/year level, because doing so carries the possibility of concealing intra-country and intra-year climatic variations. The problem is perhaps most acute with *Precipitation*, because of a greater potential for masking environmental hazards associated with rainfall variation over time. In other words, a year with significant floods and droughts could register as a "normal" year if the overall rainfall totals hewed closer to long-term averages.

To help offset this concern, I incorporate an additional measure of climate change: a count variable of the annual incidence of climatological and hydro-meteorological natural disasters occurring in a country. These include: droughts, floods, wildfires, storms, insect infestations, disease epidemics and heat waves. As climate change progresses, increasing prevalence of these disasters are anticipated to be a primary outcome (IPCC, 2014). Yet, while disasters provide an alternative measure of climate change and have been employed in prior studies (Neumayer & Plümper, 2007), they are arguably a more controversial choice because of the fact that impoverished populations, which are more likely to experience lower levels of gender equality, are also more vulnerable to disaster (Klasen, 2002). Nevertheless, when included alongside models with the climatic data, these variables can increase analytical robustness and inspire greater confidence in the findings.

I draw data for the disaster variables from the World Health Organization Collaborating Center for the Epidemiology of Disasters (CRED). According to CRED, a disaster occurs when: "(1) Ten or more people reported killed. (2) One hundred or more people reported affected. (3) Declaration of a state of emergency. (4) Call for international assistance." Approximately half (54%) of the country/year observations had zero disaster incidents, 41% had between one and five, 3% had between six and ten, and 2% had ten or greater These data are available for the entire time period under study, 1981–2010.

4.2.1. Control variables

I include a number of control variables in this analysis to account for alternative explanations that might affect the outcomes independent of the primary variables of interest. Variables were chosen based on both their theoretical relationship to the processes described in this study, and on findings from earlier research citing them as key influences on gender equality and women's rights. Data for all control variables are available for the entire time period under study, 1981–2010.

Democracy. I control for democracy because it is often assumed that democratic regimes have greater respect for human rights, including women's rights, relative to authoritarian regimes (Inglehart, Norris, & Welzel, 2002). I draw data from the well-known *Polity IV* dataset, which ranks governments on a 21-point scale from −10, "strongly autocratic" to 10, "strongly democratic" (Marshall, Gurr, & Jaggers, 2016).

Conflict. Gender equality suffers in conflict situations through direct victimization of women and through spousal and child loss. Prolonged periods of conflict can also limit a society's capacity to cultivate and develop social norms and invest in social programs that promote gender equality (Jansen, 2006). I control for a country's involvement in international or domestic conflict by including a dichotomous variable coded one if a country was a participant in a conflict and zero if not. The data are from the *Uppsala Conflict Data Program and International Peace Research Institute*, which defines conflict as: "A contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths" (Gleditsch, Wallensteen, Eriksson, Sollenberg, & Strand, 2002).

GDP/capita. I control for economic conditions that may influence women's rights. *GDP/capita* measures a country's GDP per capita, and is a conventional metric of economic development. A commonly held assumption in the development literature is that more developed countries are also likely to have greater respect for women's rights. I also include $GDP/capita^2$ to test for a curvilinear relationship between economic development and women's rights. Prior work has found the impact of development on women's rights to be contingent on the particular stage of development (Eastin & Prakash, 2013; Forsythe, Korzeniewicz, & Durrant, 2000; Boserup, 1970). Data for the *GDP/capita* variable are taken from the World Bank Databank.

Foreign direct investment (FDI). Empirical work finds that foreign direct investment can be beneficial for a society's level of gender equality because investment flows can generate employment opportunities for women (Richards & Gelleny, 2007). However, some scholars contend that policies designed to increase FDI can also reduce state revenue, and therefore diminish state's capacity for social service provision (Hemmati, 2001; Rao & Kelleher, 2005). Because women are often the key beneficiaries of these services, FDI might undermine gender equality. Furthermore, economic integration can solidify gendered occupational segregation, which forces women into poorly paid jobs (UNDP, 1999). Thus, I include *FDI*, but am agnostic as to the directionality of its effect. Data for the *FDI* variable are taken from the World Bank Databank.

Urbanization. Urbanization has been linked to increasing economic opportunities for women and greater independence relative to their rural counterparts (Tacoli & Satterthwaite, 2013). More numerous employment opportunities, lower fertility rates, and improved access to health care and social services are among the key causal drivers. However, research also suggests that urbanization can expose women to greater levels of violence and sexual harassment, and that many of the economic opportunities afforded women in urban settings reinforce occupational segregation and labor force stratification, which should diminish gender equality (Levy, 2013; Chant, 2013). In this analysis, I control for urbanization data that measure the percent of a country's population that resides in urban areas. Given the diverging expectations, I remain agnostic as to the potential directionality of effect. Data for the *Urbanization* variable are taken from the World Bank Databank.

Agriculture. Finally, I control for a country's reliance on agriculture as a means of subsistence and production. It is possible that the greater the reliance on agriculture, the lower the opportunities for female formal labor force participation, which can undermine the potential for equality gains. Additionally, heavy reliance on agriculture might also be associated with the perpetuation of pre-existing gender stereotypes because of the pervasiveness of gender inequality in agricultural sectors. For these reasons, I expect a country's agricultural dependence to be negatively associated with social and economic rights for women. To ensure model robustness, I employ two measures of agricultural dependence in the models: 1) the percentage of a country's land area devoted to agriculture, and 2) the value added of agriculture to the economy as a percentage of its overall GDP. Data for the *Agriculture* variables are taken from the World Bank Databank.

Table 1 displays the descriptive statistics for each of the variables used in the analysis.

5. Models, analysis, and results

To estimate the impact of climate change on women's rights, I employ a series of ordered-logistic regressions on a country-level panel data set covering the period 1981–2010. Ordered-logit is a preferred method for modeling independent variables that contain more than two categories of response and that are in sequential order (Agresti, 2010). All ordered-logit models were run with country-clustered robust standard errors to address possible autocorrelation at the unit level, and because these estimates tend to be more consistent across a broader range of possible forms of correlation than those derived from random effects models (Cameron & Trivedi, 2010). I include regional dummy variables in each model to account for the possibility that unobserved factors within a particular geographic region affect the outcome independent of the primary variables of interest.

To assess the robustness of these findings, I also estimate each model using ordered-probit regression and ordered-logistic regression with random effects. Additionally, while there is no consistent, universally agreed upon method for applying fixed effects to an ordered-logistic model (Baetschmann, Staub, & Winkelmann, 2015), I experimented with ordinary least squares regressions that incorporate the fixed effects assumption. All of these techniques yield results in line with those presented here, which should increase confidence in the analysis. Furthermore, because the best predictor of a country's level of gender equality in year t is often that which is present in year $t-1$, I also estimate models that include a lagged dependent variable as a predictor. The inclusion of this variable did not change the statistical significance of the variables of interest, though it did often result in higher AIC and BIC scores, indicating the variable's inclusion can be unnecessary. Finally, correlation statistics reported in the Appendix do not indicate that multicollinearity is likely to be a significant danger in this analysis. A variable correlation matrix as well as results from these alternative estimation procedures can be found in the Appendix.

Table 2 display the findings from ordered logistic regressions that estimate women's economic and social rights, respectively, across a sample of developing states from 1981 to 2010. The numbers in these tables are odds ratios, which communicate the impact of a one-unit change in each independent variable on the odds of being in the highest category of the ordinal dependent variable, holding all other variables to their mean values. Ratios greater than one reflect a positive impact on the outcome, those lower than one reflect a negative impact, and a ratio of exactly one indicates no effect. The greater the distance from one, the greater the impact should be. The figures in the parentheses are z-scores. The chi-squared goodness of fit statistics indicate that all models presented in Table 2 are significantly distinct from the null; and likelihood ratio tests reveal that including the climate change variables improves model fit to a statistically significant degree.

Variations in sample sizes in the models displayed these tables result both from temporal disparities in data coverage for the dependent variables (1981–2005 for *Social Rights*, and 1981–2010 for *Economic Rights*), and spatial disparities in data coverage between the climate and disaster variables and between the two variables approximating agricultural dependence. However, given the large

Table 1
Descriptive statistics.

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
Econ. Rights	3,662	1.15	1	0.60	0	3
Social Rights	2,877	0.99	1	0.67	0	3
Temperature	3,817	0.01	0	0.98	−2.86	3.33
Precipitation	3,817	0.00	−.041	0.98	−3.63	4.10
Disaster	4,530	1.19	0	2.44	0	30
GDP/capita	4,034	2.88	1.197	4.76	0	54.48
Democracy	3,715	0.13	0	6.80	−10	10
Ag. (% land)	4,270	39.51	39.27	21.73	0.45	86.01
Ag. (% GDP)	3,634	20.66	17.77	14.44	0.30	69.33
FDI	3,800	3.41	1.68	6.95	−82.89	161.82
Urban pop.	4,521	44.96	43.36	21.16	4.50	98.26
Conflict	4,530	0.06	0	0.24	0	2

Table 2
Ordered logit regressions, economic rights.

	Economic Rights				Social Rights			
	1	2	3	4	5	6	7	8
Temperature	0.854	0.855			0.861	0.881		
	(−2.66)***	(−2.56)**			(−2.78)***	(−2.17)**		
Precipitation	0.997	0.989			0.939	0.955		
	(−0.06)	(−0.23)			(−1.37)	(−0.92)		
Disaster			0.922	0.913			0.905	0.912
			(−2.45)**	(−3.1)***			(−2.29)**	(−2.3)**
GDP/cap.	1.12	1.136	1.113	1.127	1.041	1.163	1.041	1.107
	(1.72)*	(1.29)	(1.71)*	(1.27)	(0.41)	(0.9)	(0.42)	(0.61)
GDP/cap.^{2}	0.997	0.995	0.997	0.995	0.998	0.992	0.998	0.994
	(−1.74)*	(−1.43)	(−1.81)*	(−1.54)	(−0.7)	(−0.72)	(−0.79)	(−0.54)
Democracy	1.034	1.032	1.032	1.028	1.039	1.036	1.038	1.038
	(1.86)*	(1.58)	(1.75)*	(1.45)	(1.86)*	(1.61)	(1.84)*	(1.7)*
Ag. % land	0.993		0.994		0.994		0.995	
	(−1.07)		(−0.82)		(−0.84)		(−0.68)	
Ag. % GDP		0.995		0.992		1.017		1.013
		(−0.4)		(−0.68)		(1.21)		(0.94)
FDI	1.003	1.013	0.997	1.003	0.995	1.009	0.993	1.003
	(0.29)	(0.87)	(−0.32)	(0.25)	(−0.57)	(0.59)	(−0.86)	(0.22)
Urban pop.	0.999	0.996	1.001	0.998	1.001	1.005	1.003	1.005
	(−0.06)	(−0.33)	(0.14)	(−0.23)	(0.13)	(0.34)	(−0.31)	(0.37)
Conflict	0.49	0.437	0.552	0.498	0.743	0.682	0.819	0.744
	(−3.25)***	(−3.82)***	(−2.69)***	(−3.26)***	(−1.41)	(−1.89)*	(−0.99)	(−1.53)
Obs.	3032	2764	3091	2791	2404	2181	2450	2199
Countries	124	120	127	123	124	119	126	121
Prob. >χ^2	0	0	0	0	0	0	0	0

Ordered logit regressions with country-clustered robust standard errors.
Displayed are proportional odds ratios with z-scores in parentheses.
Ratios for regional binary variables are omitted for presentation. *p > .1, **p > .05, ***p > .01.

sample size and the number of countries included in each regression, there is little reason to suspect that the omission of these data should bias the results in ways that would undermine the paper's core conclusions.

As these tables indicate, environmental processes associated with climate change—temperature shocks and climatological/hydro-meteorological disasters—exert a significant and negative effect on women's social and economic rights, and are robust to a number of alternative explanations. These findings provide support for H1, that climate change can reduce a society's level gender equality by undermining the prevalence of social and economic rights that promote coequal status. All of the odds ratios for *Temperature* and *Disaster* indicate the existence of a modest negative impact. The influence of temperature shocks appears to generate the strongest absolute effect on women's social rights among the primary models. In Model 1, the odds ratio for Temperature indicates that for each one-unit increase in standardized temperature means in a country, the odds of full respect for women's economic rights were only 0.854 times that which would be the case had the increase in temperature not occurred. In other words, temperature increases appear to be slowing progress towards the improvement of women's rights and gender equality. This relationship is robust across all model specifications at varying degrees. Destructive climatic or hydro-meteorological disasters exert a similar effect, although lower in magnitude, as the lowest odds ratio for *Disaster* across these models is 0.905. However, it should be noted that the *Disaster* variable is less robust to alternative estimation techniques than the *Temperature* variable, as revealed in Tables A8-A10 in the Appendix. Interestingly, *Temperature* appears to exert the strongest negative impact on women's rights for all variables other than the incidence of violent armed conflict. In contrast, *Precipitation* does not appear to have a substantive effect on the outcome, as the variable was statistically insignificant and ambiguous in its directionality of effect across all models. This finding might reflect the fact that the impact of precipitation on food security and livelihoods is less consistent across time and space than that of temperature or disaster, or that the country-year unit of analysis masks important intra-annual variations in precipitation patterns.

To further probe the impact of climate change on gender equality, Table 3 displays the marginal effects that variations in temperature and disaster incidence have on the predicted probability of a country achieving a score of 0, 1, 2, or 3 on the CIRI *Economic* and

Table 3
Marginal effects.

	Temperature			Disaster		
	−2 SD	Mean	+2 SD	0 Dis.	3 Dis.	5 Dis.
Pr.(Econ Rights = 0)	0.060	0.080	0.107	0.071	0.088	0.103
(= 1)	0.689	0.723	0.742	0.717	0.737	0.746
(= 2)	0.240	0.188	0.146	0.203	0.167	0.146
(= 3)	0.011	0.008	0.006	0.009	0.007	0.006
Pr.(Soc. Rights = 0)	0.121	0.156	0.200	0.136	0.175	0.206
(= 1)	0.722	0.722	0.707	0.729	0.721	0.707
(= 2)	0.149	0.115	0.088	0.128	0.098	0.082
(= 3)	0.009	0.006	0.005	0.007	0.005	0.004

This table displays the predicted probability that a country will achieve a score of 0, 1, 2, or 3 on the CIRI Social and Economic Rights indices given changes to the key variables of interest, and holding all other variables in the equations to their central tendency. Predicted probability scores are calculated from Models 1, 3, 5, and 7, and all are statistically significant to the .05 or .01 level.

Social Rights indices, with all other variables in the equations held to their central tendency. These predictions are derived from Models 1, 3, 5, and 7 to maximize sample sizes. The predicted probabilities are calculated with the *Temperature* values set to two standard deviations below the mean (−2SD), the mean *Temperature* value, and two standard deviations above the mean (+2SD); while the *Disaster* variable is set at zero disasters, or slightly less than one standard deviation below the mean value; three disasters, or approximately one standard deviation above the mean; and five disasters, or two standard deviations above the mean.

One can draw at least two conclusions from Table 3: First, warmer temperatures and greater incidence of disaster increase the probability that a country will achieve a low CIRI score (zero or one), and decrease the probability that a country will achieve a high CIRI score (two or three) in any given year. For example, for an "average" country with a stable *Temperature* (value set to the mean), the probability of receiving a zero score on the women's *Economic Rights* index in any given year is 8%. An increase in temperature in a given year of two standard deviations above the mean increases this probability to 10.7%. In contrast, this same change decreases the probability of an average country achieving a score of two from 18.8% to 14.6%. Second, while changes in predicted probability for a given score at various values of *Temperature* or *Disaster* do not in isolation appear to be large, it is important to recognize that these reveal the probability of such a change in any given year between 1981 and 2010 (or 2005, in the case of *Social Rights*); they do not reflect the cumulative effects of such changes over a number of years. Thus, an accumulation of years of increased temperatures and disaster incidence should exert a stronger impact on the outcome than these figures reflect.

In order to assess H2, which concerns the conditionality of the findings, I split the sample set of developing countries according to their levels of economic development, agricultural dependence, and democracy. Specifically, I assess the impact of the climatic variables on samples of: 1) countries above and below the sample median for the percentage of agriculture in a country's GDP; 2) countries above and below the sample median for GDP/capita; and 3) democracies, which include those countries that rate above a five on the Polity IV scale; and non-democracies—countries that rate five and below.[4]

Additionally, in order to provide further context regarding the regional dimensions of the processes under study, I also estimate models on a 4) sample of countries located only the African continent, and on a sample excluding African countries. There are a number of reasons to believe that countries located on the African continent worthy of consideration in isolation from the larger sample set. Among them: a lack of stable, developed infrastructure; pervasiveness of violent armed conflict across the continent, including spillovers into non-conflict countries; a history of colonial exploitation and poor governance; the continent's location in tropic and sub-tropic latitudes, and, importantly, a heavy dependence on agriculture as a means of subsistence and economic production and a high degree of vulnerability to the environmental and economic effects of climate change (IPCC, 2014). Collectively, Africa also ranks last among all global regions on the Human Development Index, a comparative index that measures life expectancy, literacy, education, and living standards to determine a country's level of development (HDI 2017). Thus, according to the logic discussed previously, it is also possible that the impact of women's rights in Africa could be greater as well.[5]

For all conditionality tests, I estimate two ordinal logit models: a "sparse" model containing only the climatic variables of interest and regional dummies, and a model containing the full suite of control variables (Salehyan & Hendrix, 2014). Both estimations yield consistent results on the key variables of interest. Figs. 1 and 2 report the odds ratios and 95% confidence intervals for the *Temperature* and *Disaster* variables drawn from sparse model estimations for each of the sub-samples. These figures allow assessment of the contingency of the relationship between climate change and women's rights. Results drawn from the full models are available in the Appendix.

The results from regressions reported in Figs. 1 and 2 support H2, which suggests that climate change should exert the greatest impact on women's rights in relatively poorer, more agriculturally dependent states, with less-democratic political institutions. Comparisons of the odds ratios for the paired sample subsets indicate that *Temperature* has a more substantive and statistically significant impact on *Economic* and *Social Rights* in each of these categories than it does in countries with higher per capita GDPs, those that are less dependent on agriculture, or more democratic. The *Disaster* variables' odds ratios yield similar conclusions. The primary difference is that *Disasters* exert a more consistent effect on women's *Social* and *Economic Rights* across all eight of these sub-samples than *Temperature*, as least with respect to *Economic Rights*, though the impact of *Temperature* is slightly larger in the four sub-samples where the relationship is hypothesized to be the strongest.

[4] On the Polity IV scale, a score of 5 is the threshold that divides so-called "strong democracies" from less-democratic government types, including "open" (1–5) and "closed" (−5 to 0) "anocracies," which include traits of both democratic and autocratic systems, and fully autocratic countries (−10 to −6). I also experimented using an alternative threshold for democracy, which included all countries above a score of zero on the Polity IV scale. The significance and magnitude of the findings for the key variables of interest are insensitive to this change.

[5] To account for potential intra-regional variation in country development in Africa and to further evaluate model robustness, I also run regressions on 5) a sample of Sub-Saharan African countries, and 6) African countries that exclude those in the top decile of GDP/capita for the continent. The results for these tests are consistent with those presented here, and are included in the Appendix.

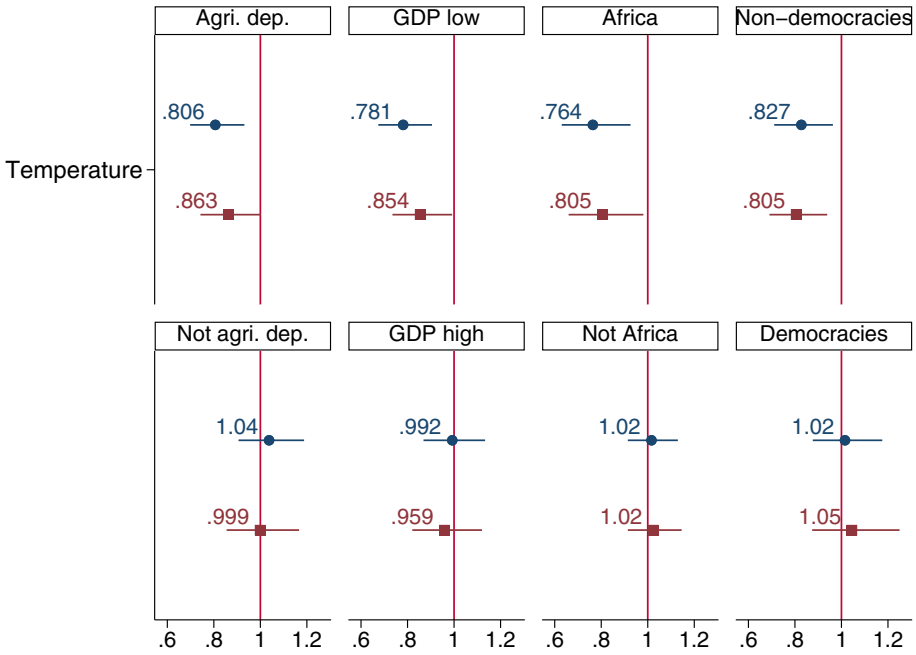

Fig. 1. Odds ratios and 95% confidence intervals for temperature shocks from sparse model ordered-logit estimations. Models run on sub-samples of countries above and below the sample median for agricultural dependence; above and below the sample median for GDP/capita; African and Non-African countries; and countries below and above a score of five on the Polity IV scale. Circles = Economic Rights; Squares = Social Rights.

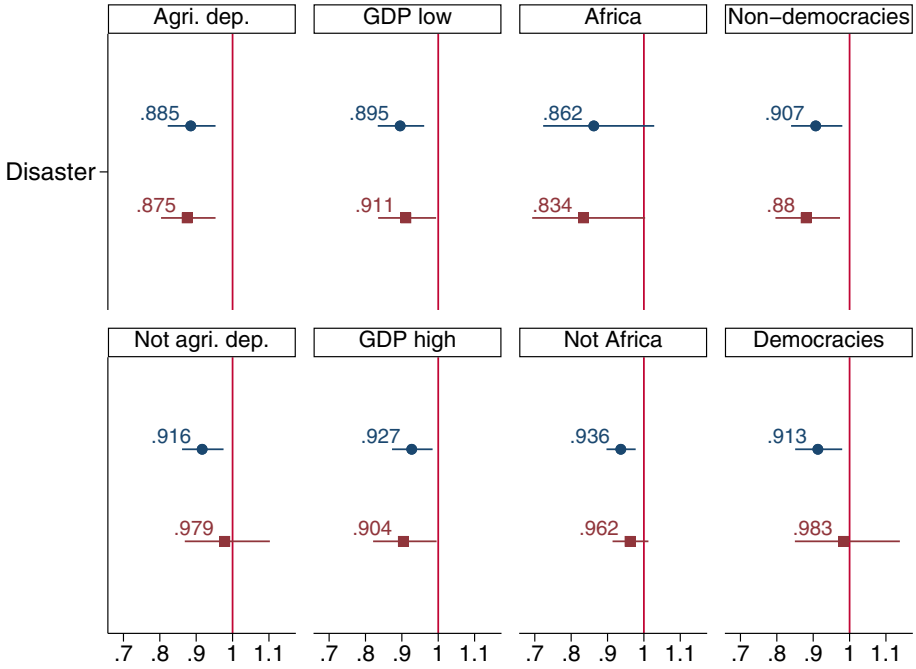

Fig. 2. Odds ratios and 95% confidence intervals for hydro-meteorological and climatic disasters from sparse model ordered-logit estimations. Models run on sub-samples of countries above and below the sample median for agricultural dependence; above and below the sample median for GDP/capita; African and Non-African countries; and countries below and above a score of five on the Polity IV scale. Circles = Economic Rights; Squares = Social Rights.

Countries located on the African continent also appear to be uniquely susceptible to the impacts of climatic variables on women's rights, as the odds ratios for these variables are negative and statistically significant in most models, and of greater impact than those in models run on the non-African sample set. These findings not only provide additional support for H2, but also substantiate the theoretical logic supporting H1, that vulnerability and livelihood sensitivity to climate change, and in particular, gendered disparities in vulnerability, can manifest across macro-social institutions to the detriment of gender equality and women's rights. Results run on sub-samples of Sub-Saharan and Low-GDP African countries provide additional support for this argument.

With respect to the control variables: First, the results reveal modest support for an inverted 'U'-shaped relationship between *GDP/capita* and *Economic Rights* in models 1 and 3, which suggests that the effect of development can be positive in very low stages of development, then turns negative as the level of development surpasses a certain threshold. Scholars such as Forsythe et al. (2000) have suggested the inverted 'U' to be a product of exploitative effects of growth as women are forced into lower-paying discrim-

inatory positions that reflect and reinforce labor market stratification. It is possible that as development progresses further, this relationship might again turn positive, when competitive labor market forces begin to penalize unequal treatment, and social development ushers in a post-materialist values orientation that further discourages gender discrimination (Eastin & Prakash, 2013). However, the inclusion of a cubic term in these models does not confirm this effect. Second, these models find modest evidence of a positive relationship between democratic political institutions and women's *Social* and *Economic Rights*, which is also in line with expectations and prior research. Next, *Agricultural Dependence* and appears to exert relatively consistent negative effects on women's rights, but the variable fails to achieve statistical significance in any of the models. The same is true for FDI and *Urbanization,* though these variables are inconsistently signed. Finally, also in line with expectations, *Conflict* appears to impose the largest absolute effect on women's rights across models, however the variable is only significant for five of the eight models.

6. Conclusion

This paper argues that income and asset inequality coupled with rising familial burdens due to male out-migration, declining subsistence resource access, and increasing vulnerability to natural disasters diminish women's ability to achieve economic independence, and enhance their human and social capital relative to men. The consequences include reduced bargaining power in the household, as women become less capable of generating independent revenue. Outside the home, discriminatory norms and unequal socio-economic status among men and women increase as women are less able to participate in formal labor markets, join civil society organizations, or collectively mobilize for political change. The overall impact magnifies constraints on the advancement of laws and norms that promote gender equality. In short, gendered disparities in climate change vulnerability not only reflect preexisting gender inequalities, they also reinforce and strengthen them. Empirical findings are consistent with this argument, indicating that states that experience greater climatic temperature variability and increasing incidence of climatological and hydro-meteorological natural disasters are also more likely to experience lower levels of women's social and economic rights.

An important implication of these findings might suggest that policies designed to facilitate climate change adaptation also include measures that address the gender inequalities in vulnerability, not only as a mechanism to promote public health, but gender equality and respect for women's rights as well. For example, a recent report issued through the Canadian International Development Agency (CIDA) outlines a number of recommendations that policymakers and non-governmental and inter-governmental organizations can take in facilitating gender-specific adaptation, including: conducting research that assesses the usefulness of adaptive technologies acceptable to both women and men; incorporating gender analysis into projects designed to identify specific climate vulnerabilities; and targeting women's needs in vulnerability reduction initiatives alongside those of men. Across all interventions, a vital means of reducing both female vulnerability would be to increasingly incorporate women into decision-making frameworks for climate adaptation and mitigation programs. Such efforts could have the effect of not only reducing climate vulnerability, but also creating another avenue for female empowerment in vulnerable contexts.

A key issue for future research should be to evaluate in greater detail the causal mechanisms underpinning the results in this analysis. This study offers a macro-story about the relationship between climate change and gender equality, and provides some of the first systematic cross-country evidence that environmental processes associated with climate change can have an adverse effect on women's social and economic rights. However, as mentioned, a key challenge with a country/year unit of analysis is capturing precise estimates of causal processes. Future empirical work would do well to further probe the conditionality of these findings and address which of the hypothesized mechanisms are most salient and under what circumstances, as they will likely vary across social, political, and economic contexts. While previous work has done an excellent job at evaluating particular mechanisms at the micro-level, there is a dearth of literature that addresses their comparability across cases.

Acknowledgements

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Appendix

Tables A1–A11

Table A1
Correlation matrix.

	Econ. Rights	Social Rights	Temp.	Precip.	Disaster	GDP/cap.
Econ. Rights	1					
Social Rights	0.63	1				
Temperature	0.03	0	1			
Precipitation	0	−0.02	−0.15	1		
Disaster	−0.03	0	0.06	0.03	1	
GDP/capita	0.13	0.10	0.09	0.01	−0.02	1
Democracy	0.24	0.30	0.16	−0.02	0.14	0.23
Ag.% land	−0.10	−0.07	0.05	0.02	0.05	−0.08
Ag.% GDP	−0.12	−0.07	−0.12	0.02	−0.09	−0.63
FDI	0.08	0.09	0.14	0.03	−0.02	0.14
Urban pop.	0.14	0.14	0.09	−0.01	0	0.59
Conflict	−0.08	−0.06	−0.04	0.04	0.12	−0.08
	Democracy	Ag.% land	Ag.% GDP	FDI	Urban pop.	Conflict
Democracy	1					
Ag. Land (%)	0	1				
Ag.% GDP	−0.30	0.04	1			
FDI	0.12	0	−0.15	1		
Urban pop.	0.30	−0.03	−0.68	0.07	1	
Conflict	0.02	−0.02	0.07	−0.04	−0.08	1

Table A2
Countries included in sample.

Albania	Gambia, The	Niger
Algeria	Georgia	Nigeria
Angola	Ghana	Oman
Argentina	Guatemala	Pakistan
Armenia	Guinea	Panama
Azerbaijan	Guinea-Bissau	Papua New Guinea
Bahrain	Guyana	Paraguay
Bangladesh	Haiti	Peru
Belarus	Honduras	Philippines
Benin	Hungary	Poland
Bhutan	India	Romania
Bolivia	Indonesia	Russia
Botswana	Iran	Rwanda
Brazil	Iraq	Saudi Arabia
Bulgaria	Jamaica	Senegal
Burkina Faso	Jordan	Sierra Leone
Burundi	Kazakhstan	Solomon Islands
Cambodia	Kenya	South Africa
Cameroon	Kuwait	Sri Lanka
Cape Verde	Kyrgyzstan	Sudan
Central African Republic	Laos	Suriname
Chad	Latvia	Swaziland
Chile	Lebanon	Syria
China	Lesotho	Tajikistan
Colombia	Liberia	Tanzania
Comoros	Libya	Thailand
Congo, Democratic Rep. of	Lithuania	Togo
Congo, Republic of	Macedonia	Trinidad and Tobago
Costa Rica	Madagascar	Tunisia
Cote d'Ivoire	Malawi	Turkey
Croatia	Malaysia	Turkmenistan
Djibouti	Mali	Uganda
Dominican Republic	Mauritania	Ukraine
East Timor	Mauritius	United Arab Emirates
Ecuador	Mexico	Uruguay
Egypt	Moldova	Uzbekistan
El Salvador	Mongolia	Venezuela
Equatorial Guinea	Montenegro	Vietnam
Eritrea	Morocco	Yemen
Estonia	Mozambique	Zambia
Ethiopia	Namibia	Zimbabwe
Fiji	Nepal	
Gabon	Nicaragua	

Table A3
Ordered logistic regressions: GDP/capita.

	Low GDP				High GDP			
	Econ. Rights		Social Rights		Econ. Rights		Social Rights	
	1	2	3	4	5	6	7	8
Temp.	0.765		0.815		1		0.922	
	(−3.4)***		(−2.7)***		(0.01)		(−0.99)	
Precip.	0.961		0.944		1.059		0.972	
	(−0.55)		(−0.85)		(1.03)		(−0.5)	
Disaster		0.907		0.906		0.933		0.872
		(−2.37)**		(−1.68)*		(−1.73)*		(−3.2)***
Democ.	0.988	0.981	0.994	0.99	1.086	1.086	1.086	1.091
	(−0.68)	(−1.11)	(−0.24)	(−0.43)	(3.08)***	(3.07)***	(2.25)**	(2.41)**
Ag.% land	1	1.003	0.996	0.998	0.985	0.985	0.992	0.992
	(0.01)	(0.3)	(−0.43)	(−0.18)	(−2.04)**	(−1.91)*	(−0.95)	(−1.01)
FDI	0.994	0.991	0.989	0.986	1.013	1.008	0.999	1.001
	(−0.65)	(−1.19)	(−1.45)	(−1.75)*	(0.8)	(0.54)	(−0.03)	(0.04)
U. pop.	1.018	1.019	1.026	1.028	0.992	0.994	0.985	0.988
	(1.4)	(1.55)	(1.76)*	(1.88)*	(−0.87)	(−0.65)	(−1.47)	(−1.19)
Conflict	0.522	0.601	0.835	0.912	0.45	0.495	0.543	0.608
	(−3.3)***	(−2.5)**	(−0.87)	(−0.47)	(−1.33)	(−1.16)	(−1.08)	(−0.88)
Obs.	1641	1657	1415	1426	1394	1437	992	1027
Countries	88	89	88	89	88	90	74	75
Prob. $>\chi^2$	0	0	0	0	0	0	0	0

Ordered logistic regressions with country-clustered robust standard errors. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation.
*p > .1, **p > .05, ***p > .01.

Table A4
Ordered logistic regressions: agricultural dependence.

	Low Agriculture				High Agriculture			
	Econ. Rights		Social Rights		Econ. Rights		Social Rights	
	1	2	3	4	5	6	7	8
Temp.	0.809		0.845		0.944		0.884	
	(−2.7)***		(−2.17)**		(−0.71)		(−1.52)	
Precip.	0.997		0.908		0.992		0.992	
	(−0.06)		(−1.44)		(−0.12)		(−0.14)	
Disaster		0.903		0.884		0.917		0.905
		(−2.8)***		(−2.50)**		(−2.43)**		(−2.48)**
GDP/cap	1.038	1.009	0.905	0.914	1.189	1.198	1.053	1.027
	(0.55)	(0.14)	(−0.67)	(−0.65)	(1.64)	(1.75)*	(0.34)	(0.18
GDP/cap^2	0.998	0.999	1.001	1	0.993	0.993	1	1
	(−1.38)	(−0.92)	(0.21)	(−0.05)	(−1.48)	(−1.64)	(0.04)	(0.04)
Democ.	1.002	0.998	1.01	1.009	1.076	1.071	1.076	1.079
	(0.08)	(−0.1)	(0.43)	(0.38)	(2.50)**	(2.40)**	(2.15)**	(2.26)**
FDI	0.997	0.992	0.985	0.983	1.018	1.01	1.023	1.019
	(−0.43)	(−1.09)	(−1.82)*	(−2.04)**	(1.28)	(0.73)	(1.09)	(0.88)
U. pop.	1.013	1.014	1.021	1.024	0.988	0.99	0.987	0.988
	(1.05)	(1.12)	(1.49)	(1.70)*	(−1.12)	(−0.89)	(−1.19)	(−1.09)
Conflict	0.54	0.634	0.771	0.87	0.472	0.515	0.836	0.923
	(−2.8)***	(−2.01)**	(−1.11)	(−0.62)	(−1.58)	(−1.39)	(−0.49)	(−0.22)
Obs.	1707	1747	1430	1461	1336	1355	982	997
Countries	100	102	99	101	78	80	74	75
Prob. >χ^2	0	0	0	0	0	0	0	0

Ordered logistic regressions with country-clustered robust standard errors. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation.
*p > .1, **p > .05, ***p > .01.

Table A5
Ordered logistic regressions: Africa.

	Africa				Not Africa			
	Econ. Rights		Social Rights		Econ. Rights		Social Rights	
	1	2	3	4	5	6	7	8
Temp.	0.711		0.745		0.931		0.899	
	(−3.5)***		(−2.8)***		(−0.95)		(−1.54)	
Precip.	0.958		0.911		1.02		0.946	
	(−0.58)		(−1.37)		(0.35)		(−0.9)	
Disaster		0.928		0.83		0.953		0.935
		(−0.92)		(−1.97)**		(−1.57)		(−1.76)*
GDP/cap.	1.04	1.024	0.685	0.737	1.059	1.056	0.956	0.945
	(0.21)	(0.13)	(−1.21)	(1.06)	(0.82)	(0.83)	(−0.38)	(−0.53)
GDP/cap.^{2}	1.006	1.005	1.029	1.025	0.998	0.998	1	1
	(0.6)	(0.49)	(1.31)	(1.19)	(−1.09)	(−1.17)	(0.1)	(−0.02)
Democ.	0.997	0.991	1.033	1.03	1.101	1.1	1.125	1.13
	(−0.18)	(−0.52)	(1.2)	(1.06)	(3.63)***	(3.88)***	(4.00)***	(4.40)***
Ag.% land	1.01	1.01	1	0.999	0.987	0.988	0.998	0.999
	(1.24)	(1.27)	(0.01)	(−0.09)	(−1.72)*	(−1.62)	(−0.26)	(−0.08)
FDI	0.989	0.986	0.983	0.981	1.031	1.021	1.07	1.063
	(−1.36)	(−1.85)*	(−1.68)*	(−1.84)*	(1.82)*	(1.3)	(3.14)***	(−2.9)***
U. pop.	1.024	1.021	1.02	1.017	0.995	0.994	0.995	0.992
	(1.96)*	(1.70)*	(1.14)	(0.99)	(−0.66)	(−0.7)	(−0.47)	(−0.67)
Conflict	0.662	0.643	1.007	1.002	0.389	0.455	0.499	0.606
	(−1.69)*	(−1.72)*	(0.02)	(0.01)	(−2.46)**	(−1.99)**	(−1.94)*	(−1.43)
Obs.	1257	1267	1026	1036	1775	1824	1378	1414
Countries	50	50	50	50	74	77	74	76
Prob. >χ^2	0	0	0.26	0.14	0	0	0.1	0

Ordered logistic regressions with country-clustered robust standard errors. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation.
*p > .1, **p > .05, ***p > .01.

Table A6
Ordered logistic regressions: Africa.

	Africa, Low GDP				Sub-Saharan Africa			
	Econ. Rights		Social Rights		Econ. Rights		Social Rights	
	1	2	3	4	5	6	7	8
Temp.	0.714		0.752		0.7		0.727	
	(−3.6)***		(−2.8)***		(−3.4)***		(−2.7)***	
Precip.	0.965		0.914		0.956		0.902	
	(−0.48		(−1.32)		(−0.58)		(−1.31)	
Disaster		0.935		0.828		0.946		0.882
		(−0.85)		(−1.99)**		(−0.62)		(-1.27)
GDP/cap.	0.904	0.995	0.382	0.415	1	1.026	0.694	0.726
	(−0.32	(−0.02)	(−1.98)**	(−1.96)**	(0)	(0.13)	(−1.09)	(−0.99)
GDP/cap.^{2}	1.033	1.009	1.17	1.15	1.008	1.004	1.029	1.025
	(0.63	(0.19)	(1.98)**	(2.18)**	(0.73)	(0.42)	(1.27)	(1.11)
Democ.	0.994	0.989	1.034	1.034	1.001	0.992	1.018	1.014
	(−0.36	(−0.67)	(1.24)	(1.19)	(0.06)	(−0.46)	(0.64)	(0.49)
Ag.% land	1.01	1.01	1.002	1.001	1.011	1.01	1	0.999
	(1.22	(1.23)	(0.16)	(0.13)	(1.22)	(1.12)	(0.03)	(−0.09)
FDI	0.99	0.987	0.983	0.981	0.99	0.987	0.98	0.978
	(−1.28	(−1.73)*	(−1.80)*	(−1.94)*	(−1.21)	(−1.74)*	(−2.06)**	(−2.17)**
U. pop.	1.026	1.022	1.025	1.022	1.021	1.017	1.029	1.026
	(−2.17)**	(1.77)*	(1.43)	(1.27)	(1.64)	(1.39)	(1.62)	(1.47)
Conflict	0.663	0.643	1.009	1.002	0.683	0.651	1.124	1.103
	(−1.68)*	(−1.72)*	(0.03)	(0.01)	(−1.53)	(−1.64)	(0.45)	(0.37)
Obs.	1239	1249	1023	1033	1132	1132	924	924
Countries	50	50	50	50	45	45	45	45
Prob. >χ^2	0	0.006	0.18	0.03	0	0	0.16	0.20

Ordered logistic regressions with country-clustered robust standard errors. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation.
p > .1, p > .05, p > .01.

Table A7
Ordered logistic regressions: democracy.

	Democracy				Non-Democracy			
	Econ. Rights		Social Rights		Econ. Rights		Social Rights	
	1	2	3	4	5	6	7	8
Temp.	0.933		1.023		0.828		0.766	
	−(0.88)		(0.24)		(−2.18)**		(−3.4)***	
Precip.	0.956		1.045		1.026		0.901	
	(−0.71)		(0.65)		(0.44)		(−1.65)*	
Disaster		0.916		0.934		0.914		0.888
		(−1.85)*		(−0.85)		(−2.37)**		(−2.25)**
GDP/cap.	1.292	1.318	1.619	1.617	0.966	0.96	0.788	0.811
	(3.56)***	(4.28)***	(−3.4)***	(3.81)***	(−0.37)	(−0.47)	(−1.94)*	(−1.90)*
GDP/cap^2	0.993	0.992	0.971	0.972	1	1	1.005	1.004
	(−2.79)***	(−3.4)***	(−3.8)***	(−3.9)***	(0.13)	(0.15)	(1.92)*	(1.77)*
Ag.% land	1.001	1	1.004	1.003	0.987	0.988	0.989	0.99
	(0.1)	(0.03)	(0.43)	(0.29)	(−1.6)	(−1.38)	(−1.22)	(1.16)
FDI	1.012	1.007	1.002	1.009	0.997	0.994	0.987	0.985
	(0.5)	(0.33)	(0.06)	(0.28)	(−0.3)	(−0.67)	(−1.61)	(−1.80)*
U. pop.	0.989	0.992	0.98	0.986	1.013	1.014	1.022	1.021
	(−1.03)	(−0.77)	(−1.65)*	(−1.29)	(1.41)	(1.52)	(1.97)**	(1.93)*
Conflict	0.657	0.901	0.771	0.891	0.454	0.468	0.907	0.939
	(−1.21)	(−0.45)	(−0.65)	(−0.38)	(−2.7)***	(−2.6)***	(−0.37)	(−0.25)
Obs.	1314	1425	939	989	1831	1874	1527	1565
Countries	84	97	83	96	108	109	106	107
Prob. >χ^2	0	0	0	0	0	0	0	0

Ordered logistic regressions with country-clustered robust standard errors. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation.
*p > .1, **p > .05, ***p > .01.

Table A8
Ordered probit regressions.

	Econ. Rights		Social Rights	
	1	2	3	4
Temperature	0.92		0.918	
	(−2.65)***		(−2.90)***	
Precipitation	1.002		0.961	
	(0.07)		(−1.62)	
Disaster		0.955		0.943
		(−2.49)**		(−2.45)**
GDP/capita	1.062	1.059	1.025	1.025
	(1.70)*	(1.69)*	(0.45)	(0.47)
GDP/capita^2	0.998	0.998	0.999	0.999
	(−1.72)*	(−1.78)*	(−0.74)	(−0.84)
Democracy	1.018	1.017	1.021	1.021
	(1.91)*	(1.78)*	(1.95)*	(1.90)*
Ag.% land	0.996	0.997	0.997	0.998
	(−1.03)	(−0.78)	(−0.68)	(−0.54)
FDI	1.001	0.998	0.997	0.996
	(0.11)	(−0.5)	(−0.57)	(−0.89)
Urban pop.	1	1.001	1.001	1.002
	(0.02)	(0.2)	(0.25)	(0.4)
Conflict	0.674	0.722	0.852	0.905
	(−3.27)***	(−2.71)***	(−1.26)	(−0.8)
Observations	3032	3091	2404	2450
Countries	124	127	124	126
Prob. >χ^2	0	0	0	0

Ordered probit regressions with country-clustered robust standard errors. Displayed are regression coefficients with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation. *p > .1, **p > .05, ***p > .01.

Table A9
Ordered logistic regressions with random effects.

	Econ. Rights		Social Rights	
	1	2	3	4
Temperature	0.884		0.854	
	(−2.56)**		(−2.75)***	
Precipitation	1.012		0.939	
	0.28		−1.18	
Disaster		0.966		0.944
		−1.25		−1.57
GDP/capita	1.081	1.072	1.218	1.244
	(2.06)**	(1.87)*	(3.04)***	(3.43)***
GDP/capita^2	0.998	0.998	0.995	0.995
	(−2.40)**	(−2.38)**	(−2.59)***	(−2.80)***
Democracy	0.981	0.978	0.985	0.983
	(−1.65)*	(−1.88)*	−1.13	−1.26
Ag.% land	0.999	0.999	0.999	0.999
	−0.14	−0.21	−0.16	−0.15
FDI	0.99	0.988	0.984	0.984
	−1.14	−1.39	−1.5	−1.53
Urban pop.	1.008	1.006	0.992	0.989
	1.02	0.74	−0.72	−1.1
Conflict	0.742	0.759	0.842	0.852
	−1.5	−1.39	−0.77	−0.73
Observations	3032	3091	2404	2450
Countries	124	127	124	126
Prob. >χ^2	0	0	0	0

Ordered logistic regressions with random effects. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation. *p > .1, **p > .05, ***p > .01.

Table A10
Ordinary least squares regressions with fixed effects.

	Econ. Rights		Social Rights	
	1	2	3	4
Temperature	−0.021		−0.024	
	(2.29)**		(−2.35)**	
Precipitation	0.004		−0.01	
	(0.45)		(−1.1)	
Disaster		−0.001		−0.005
		(−0.21)		(−0.72)
GDP/capita	0.013	0.011	0.037	0.041
	(1.68)*	(1.49)	(3.19)***	(3.60)***
GDP/capita^2	0	0	−0.001	−0.001
	(2.34)**	(2.32)**	(−2.84)***	(−3.12)***
Democracy	−0.006	−0.006)	−0.005	−0.005
	(−2.54)**	(−2.70)***	(−1.85)*	(−1.92)*
Ag.% land	0.004	0.004	0.001	0.001
	(1.64)	(1.37)	(0.33)	(0.25)
FDI	−0.002	−0.002	−0.002	−0.002
	(−1.21)	(−1.34)	(−1.34)	(−1.34)
Urban pop.	0.001	0	−0.003	−0.004
	(0.55)	(0.08)	(−1.08)	(−1.68)*
Conflict	−0.038	−0.035	−0.023	−0.021
	(−1.05)	(−0.96)	(−0.6)	(−0.55)
Constant	0.869	0.97	1.006	1.081
	(6.42)***	(7.51)***	(6.58)***	(7.33)***
Observations	3032	3091	2404	2450
Countries	124	127	124	126
Probability > *F*	0.01	0.02	0	0

Ordinary least squares regressions with unit fixed effects. Displayed are regression coefficients with t-scores in parentheses. *p > .1, **p > .05, ***p > .01.

Table A11
Ordered logistic regressions with lagged dependent variable.

	Econ. Rights		Social Rights	
	1	2	3	4
Temperature	0.891		0.898	
	(−2.37)**		(−1.72)*	
Precipitation	1.037		0.94	
	(0.73)		(−0.96)	
Disaster		0.959		0.959
		(2.05)**		(−1.78)*
Lagged DV	23.123	22.715	36.5	36.92
	(22.12)***	(22.34)***	(24.57)***	(24.35)***
GDP/capita	1.072	1.067	1.038	1.051
	(1.91)*	(1.83)*	(0.57)	(0.81)
GDP/capita^2	0.998	0.998	0.999	0.998
	(−1.58)	(−1.58)	−0.63	(−0.94)
Democracy	1.016	1.014	(1.02)	1.019
	(1.51)	(1.33)	(1.79)*	(1.63)
Ag.% land	0.994	0.995	0.997	0.997
	(−1.62)	(−1.4)	(−0.82)	(−0.81)
FDI	0.99	0.986	0.982	0.981
	(−1.51)	(−2.27)**	(−2.32)**	(−2.63)***
Urban pop.	1.001	1.002	1.001	1.001
	(0.24)	(0.43)	(0.09)	(0.2)
Conflict	0.589	0.62	0.843	0.875
	(−2.86)***	(−2.61)***	(−0.65)	(−0.52)
Observations	2903	2960	2146	2188
Countries	124	127	123	125
Probability > χ^2	0	0	0	0

Ordered logistic regressions with country-clustered robust standard errors and a lagged dependent variable. Displayed are proportional odds ratios with z-scores in parentheses. Coefficients for regional binary variables are omitted for presentation. *p > .1, **p > .05, ***p > .01.

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